Active Project (2014 - 2016)

Robonaut 2 (R2) Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)

ANTICIPATED BENEFITS

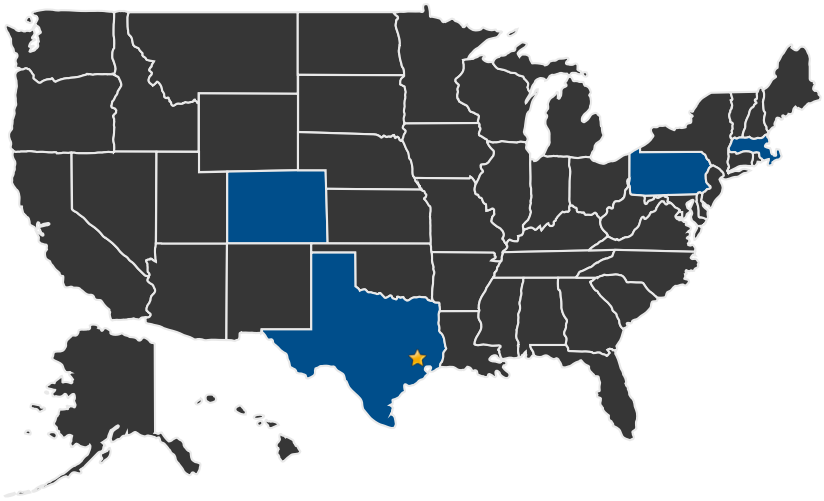
To NASA funded missions:

Robonaut's ability to autonomously climb within the ISS will allow R2 to translate to various locations within ISS to perform useful work for the crew thereby off-loading the crew from those activities. This work will also serve as a on-orbit testbed for future exploration activities, infusing new capabilities from academia and industry. Robonaut hand technology is currently being integrated into a space suit glove as part of the GCD next generation life support project.

DETAILED DESCRIPTION

R2 is the humanoid robot currently on ISS. R2 is designed to off-load routine and repetitive work from the crew. The crew can then spend more time on science and research.

U.S. WORK LOCATIONS AND KEY PARTNERS

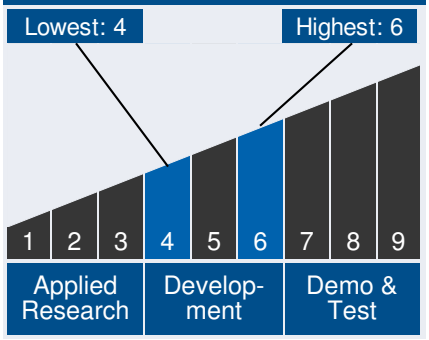


U.S. States With Work

Lead Center:
Johnson Space Center

Table of Contents

Technology Maturity



Management Team

Program Executive:
- Lanetra Tate

Program Manager:
- Mary Wusk

Continued on following page.

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Other Organizations Performing Work:

- Carnegie Mellon University
- Jacobs Engineering
- Oceaneering Space Systems
- Rice University
- S&K Aerospace, Inc. (St Ignatius, MT)
- SAIC
- The University of Texas at Austin
- University of Colorado, Boulder
- University of Massachusetts, Amherst
- WYLE Integration Science & Engineering

Management Team *(cont.)*

Project Manager:

- William Bluethmann

Principal Investigator:

- Robert Ambrose

Technology Areas

- Robotics and Autonomous Systems (TA 4)
- Sensing and Perception (TA 4.1)
- Manipulation Object State Estimation (TA 4.1.2.8)
- Space-Qualifiable Force and Torque Sensors (TA 4.1.5.1)
- Adaptive Autonomous Surface Navigation (TA 4.2.6.1)
- Autonomous Navigation for Tethered Systems (TA 4.2.6.2)
- Low-Altitude Above-Surface Navigation (TA 4.2.6.3)
- Below-Surface Navigation (TA 4.2.6.4)
- Small-Body/Microgravity Navigation (TA 4.2.6.5)
- Actuators (TA 4.3.1.1)
- Motor Controllers (TA 4.3.1.3)
- Manipulator Concepts (TA 4.3.1.4)
- Dexterous Manipulator Arms (TA 4.3.2.1)
- Dexterous Manipulator End Effectors (TA 4.3.2.2)
- Mobile Manipulation (TA 4.3.4.1)
- Collaborative Manipulation (TA 4.3.5.1)
- Grappling (TA 4.3.7.1)

DETAILS FOR TECHNOLOGY 1

Technology Title

Autonomous task software

Technology Description

This technology is categorized as a software macro for other applications

Path planning and obstacle avoidance software algorithms for robot mobility.

Capabilities Provided

R2 autonomous task software will provide R2 the capability to maneuver (climb) within the ISS Lab module without crew assistance. Additionally, R2 will be able to stow and un-stow itself without crew assistance.

Potential Applications

Path planning and obstacle avoidance algorithms may be applied to other robotic systems needing an autonomous maneuvering capability.

Performance Metrics

Metric	Unit	Quantity
Autonomy	%	95
On-orbit Demonstrations		5

Technology Areas

Primary Technology Area:
Robotics and Autonomous Systems (TA 4)
└ Sensing and Perception (TA 4.1)
  └ State Estimation (TA 4.1.2)
    └ Manipulation Object State Estimation (TA 4.1.2.8)

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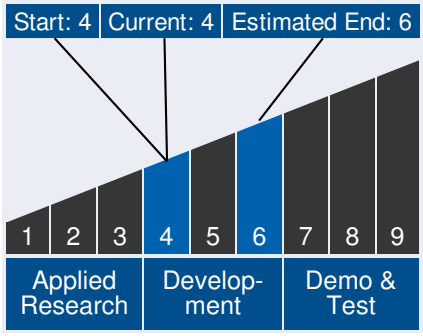
Technology Areas *(cont.)*

Additional Technology Areas:

- Robotics and Autonomous Systems (TA 4)
  - Sensing and Perception (TA 4.1)
    - Force and Tactile Sensing (TA 4.1.5)
      - Space-Qualifiable Force and Torque Sensors (TA 4.1.5.1)
  - Mobility (TA 4.2)
    - Robot Navigation (TA 4.2.6)
      - Adaptive Autonomous Surface Navigation (TA 4.2.6.1)
      - Autonomous Navigation for Tethered Systems (TA 4.2.6.2)
      - Low-Altitude Above-Surface Navigation (TA 4.2.6.3)
      - Below-Surface Navigation (TA 4.2.6.4)
      - Small-Body/Microgravity Navigation (TA 4.2.6.5)
  - Manipulation (TA 4.3)
    - Manipulator Components (TA 4.3.1)
      - Actuators (TA 4.3.1.1)
      - Motor Controllers (TA 4.3.1.3)
      - Manipulator Concepts (TA 4.3.1.4)
    - Dexterous Manipulation (TA 4.3.2)
      - Dexterous Manipulator Arms (TA 4.3.2.1)
      - Dexterous Manipulator End Effectors (TA 4.3.2.2)

Technology Maturity



DETAILS FOR TECHNOLOGY 2

Technology Title

Computer vision

Technology Description

This technology is categorized as a software macro for other applications

Robonaut 2 uses cameras and depth indicators in the head and End Effectors for object recognition and pose determination.

Capabilities Provided

R2's computer vision capability will provide R2 the capability to maneuver (climb) within the ISS Lab module without crew assistance. Additionally, R2 will be able to stow and un-stow itself without crew assistance.

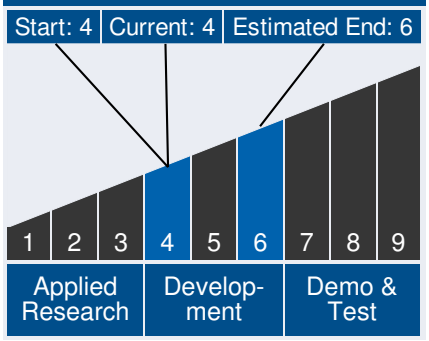
Potential Applications

Computer vision may be applied to other robotic systems needing an autonomous maneuvering capability.

Technology Areas

Secondary Technology Area:
Robotics and Autonomous Systems (TA 4)

Technology Maturity



Performance Metrics

Metric	Unit	Quantity
On-orbit Demonstrations		5
Autonomy	%	95